Before the
FEDERAL COMMUNICATIONS COMMISSION
Washington, DC 20554

In the Matter of	)	
	)	
Inquiry Regarding Carrier Current Systems	)	ET Docket No. 03-104
Including Broadband Over Power Line Systems	)	

COMMENTS OF THE
NATIONAL ACADEMY OF SCIENCES'
COMMITTEE ON RADIO FREQUENCIES

The National Academy of Sciences, through the National Research Council's Committee on Radio Frequencies (hereinafter, CORF[1]), hereby submits its comments in response to the Commission's February 23, 2004, Notice of Proposed Rulemaking in the above-captioned docket (NPRM). In these comments, CORF supports the Commission's proposals for protecting existing users of the spectrum from potential interference from broadband-over-powerline (BPL) transmissions.

I. Introduction: The Role of Radio Astronomy and the Unique Vulnerability of Passive Services to Interference.

CORF has a substantial interest in this proceeding, as it represents the interests of the passive scientific users of the radio spectrum, including users of the Radio Astronomy Service (RAS) bands. RAS observers perform extremely important yet vulnerable research.

As the Commission has long recognized, radio astronomy is a vitally important tool used by scientists to study our universe. It was through the use of radio astronomy that scientists

[1] A roster of the committee is attached.

discovered the first planets outside the solar system, circling a distant pulsar. Measurements of radio spectral line emission have identified and characterized the birth sites of stars in our own galaxy, and the complex distribution and evolution of galaxies in the universe. Radio astronomy measurements have discovered ripples in the cosmic microwave background, generated in the early universe, which later formed the stars and galaxies we know today. Observations of supernovas have allowed us to witness the creation and distribution of heavy elements essential to the formation of planets like Earth, and of life itself.

The emissions that radio astronomers review are extremely weak—a typical radio telescope receives less than *one-trillionth of a watt* from even the strongest cosmic source. Because radio astronomy receivers are designed to detect such remarkably weak signals, such facilities are therefore particularly vulnerable to interference from in-band emissions, spurious and out-of-band emissions from licensed and unlicensed users of neighboring bands, and emitters that produce harmonic emissions that fall into the RAS bands.

In addition to the gains in scientific knowledge that result from radio astronomy, CORF notes that such research spawns technological developments that are of direct and tangible benefit to the public. For example, radio astronomy techniques have contributed significantly to major advances in the following areas:

> —*Computerized tomography* (CAT scans) as well as other technologies for studying and creating images of tissue inside the human body;
>
> —Increasing abilities to *forecast earthquakes* by the use of very-long-baseline interferometric (VLBI) measurements of fault motions; and
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> —Use of VLBI techniques in the development of *wireless telephone geographic location technologies*, which can be used in connection with the Commission's E911 requirements.

Continued development of new critical technologies arising from passive scientific observation of the spectrum requires that scientists have continued access to interference-free spectrum. More directly, the underlying science cannot be performed unless observers have access to interference-free spectrum. Loss of such access constitutes a loss for the scientific and cultural heritage of all people, as well as a loss of the practical applications that come from the information learned and the technologies developed.

While radio astronomers make observations at many frequencies that could be affected by emissions from BPL systems, CORF is particularly concerned about the following frequencies, which are subject to specific protections in the Commission's rules:

13.36-13.41 MHz – RAS has the sole domestic primary allocation in this band.
25.55-25.67 MHz – RAS has the sole domestic primary allocation in this band.
37.50-38.0 MHz – RAS has a secondary domestic allocation in this band.
38.0-38.25 MHz – RAS has the sole domestic primary allocation in this band.
73.0-74.60 MHz – RAS has the sole domestic primary allocation in this band.
406.1-410.0 MHz – RAS has the sole domestic primary allocation in this band.
608-614 MHz – RAS has a co-primary domestic allocation in this band.[2]

Observations in these bands are important for studying the interstellar medium, pulsars, and the Sun, as well as for the study of thermal and nonthermal diffuse radiation in our Milky Way Galaxy. Such observations give information on the high-energy cosmic-ray particles in our galaxy and their distribution, and also on the hot ionized plasma in the disk of our galaxy.

Observations in these bands are also very important for the study of pulsars, which are highly condensed neutron stars that rotate with a period as short as a millisecond, and are commonly the remains of supernova outbursts. The discovery and study of such objects in the

[2]In addition, the Commission's Table of Allocations lists International Footnote S5.149, which urges administrations to take all practicable steps to protect RAS observations at 150.05-153.0 and 322-328.6 MHz from harmful interference.

last two decades have opened up a major new chapter in the physics of extremely dense matter and have contributed immensely to our understanding of black holes and the final state in stellar evolution. Observations of binary pulsars by radio astronomers have verified the existence of gravitational radiation at the level predicted by the theory of relativity.

Lastly, important observations in these bands enable study of radio frequency outbursts from our Sun. These bursts of high-energy particles interact with Earth's atmosphere and can cause severe interruptions in radio communications and power systems, and can also have dangerous effects on aircraft flights at altitudes above 15,000 meters. Study of these solar bursts aims to allow prediction of failures in radio communications. In addition, knowledge regarding high-energy solar bursts is essential for successful space exploration, both manned and unmanned.

II. CORF Supports the Current and Proposed Additional Part 15 Protections from Potential Interference.

The Commission has long recognized the importance of protecting RAS observations from unwanted interference, not only generally, but also in the specific context of Part 15. Section 15.205(a) prohibits intentional transmissions by unlicensed devices in *each* of the above-listed bands allocated to the RAS (with the exception of the band at 406.1-410 MHz), as well as to the 322.0-328.6 MHz band that receives footnote protection.[3] More generally, the RAS, like the

[3]The presence in Section 15.205(a) of numerous frequencies that are allocated *solely* to the RAS is consistent with the principle, stated in the NPRM, that unlicensed devices must protect receivers in *all* services, passive as well as active. *See* NPRM at para. 39 ("Thus, [Access BPL] operations must cease if harmful interference to licensed *services* is caused." [Emphasis added.] No distinction was made by the Commission between active and passive services).

licensed services, receives other protections from interference by unlicensed devices. Sections 15.109 and 15.209 set specific limits on emissions from intentional and unintentional radiators at various frequency bands. More important, under the requirements of Section 15.5 of the Commission's rules, all unlicensed devices are subject to the condition that they not cause harmful interference and that they cease operation if they do cause such interference.[4] CORF believes that removing or weakening these long-standing protections would significantly increase the likelihood of interference with RAS observations, and thus CORF strongly supports maintaining these protections and applying them to BPL.

Despite existing Part 15 protections, CORF believes that the current uncertainty regarding the transmission characteristics of various BPL technologies (both present and future),[5] as well as other information in the record, supports the enactment of the additional protections proposed in paragraphs 39-43 of the NPRM. Two proposals require that BPL systems and devices enable use of adaptive interference mitigation techniques that would allow BPL operators to reduce power levels on a dynamic or remote-controlled basis, and to shut down devices found to cause harmful interference. CORF strongly supports these requirements as a practical implication of the Section 15.5 requirement that operators of unlicensed devices shut them down if the devices cause harmful interference. The provisions of Section 15.5 are of limited or no utility if required power modifications cannot be made at all, or cannot be made in a timely manner. Similarly,

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[4] *See* NPRM at para. 34.

[5] CORF recognizes that the NPRM seeks comments on proposed guidelines for measurement of emissions from BPL systems. However, in light of the fact that BPL equipment is and will be manufactured by multiple vendors, and given the current lack of generally accepted documented studies of BPL transmission characteristics, CORF can take no position at this time regarding the accuracy and efficacy of the guidelines proposed in the NPRM.

CORF supports the NPRM's proposal for a notification requirement wherein BPL operators would submit information on their systems to an industry-operated entity for creation of a database to identify operators and technical characteristics, so as to facilitate resolution of interference problems.[6] Again, reliance on Part 15's current non-interference requirements is of little value if the source of the BPL interference, or the operator, cannot be identified. CORF has concerns regarding the potential production of harmonics when a BPL signal reaches any legitimate non-linear device (power rectifiers, etc.) connected to the power line, possibly some distance from the originating BPL transmitter. The nature of the radiation mechanism is such that harmonics will be enhanced by 20 dB per decade of frequency up to frequencies where the size of the radiating device is comparable to the wavelength. The likely result will be increased difficulty in identifying the real source of any interference, making the availability of an efficient database to enable identification of BPL operators all the more important.

CORF also notes that the NPRM proposes a requirement that BPL devices be able to reduce the level of transmissions at specific frequencies or avoid the use of certain frequencies. CORF strongly supports such "notching out" of the relevant frequencies allocated on a primary

[6]In considering the content and level of detail of information in such a database, the NPRM references Section 90.35(g) of the Commission's Rules. While there is some uncertainty regarding the specifics of BPL system architectures and the possible difficulties in identifying interference caused by BPL systems, the requirements set forth in Section 90.35 for data on power line carrier systems (frequency, power, location of transmitters, and "other technical and operating parameters") may be an appropriate model for a BPL database. In light of the possibility of BPL lines acting as transmitters, the Commission may want to add a requirement for identifying entire lines used by a specific BPL operator. In addition, the Commission should ensure that the information in the database is reasonably accessible by registered RAS parties seeking to resolve interference issues.

basis to the RAS, such as 13.36-13.41 MHz, 25.55-25.67 MHz, 38.0-38.25 MHz,[7] and 73.0-74.60 MHz. CORF recognizes that other incumbent services could make similar "not in my backyard" requests for notching. Nevertheless, CORF believes that such protection for the RAS is particularly warranted since the RAS is a *passive* rather than an *active* user of the spectrum and thus as a general matter is more vulnerable to interference than are active services. Moreover, in order to pick up cosmic transmissions, RAS receivers are substantially more sensitive than receivers in other services; tiny variations relative to the noise floor constitute the entire RAS signal.

In regard to the degree of "notching" that should be required, CORF notes that as a general matter, Recommendation ITU-R RA.769 establishes interference thresholds for radio astronomy observations and could be used as the basis for a notching requirement. CORF urges consideration of such a requirement. At the very least, however, BPL equipment should be notched so that emissions do not exceed 100 microvolts per meter (measured at a distance of 3 meters) at 13.36-13.41 MHz, 25.55-25.67 MHz, 37.5-38.25 MHz, and 73.0-74.60 MHz.[8]

III. Conclusion.

The Commission has long recognized the importance of protecting RAS observations from unwanted interference, not only generally, but also in the specific context of Part 15. CORF

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[7]The RAS has a secondary allocation at 37.50-38.0 MHz, with the Land Mobile Service having the primary allocation in that band. Nevertheless, given the mobile, itinerant nature of the primary service, compared with the fixed nature of BPL operations, CORF asserts that if 38.0 - 38.25 MHz is to be notched out, then 37.50-38.0 MHz should be notched out as well.

[8]*See* Section 15.109(a) of the Commission's rules.

supports the proposals in the NPRM to maintain existing Part 15 protections for services such as RAS, and to enact additional protections.

Respectfully submitted,
NATIONAL ACADEMY OF SCIENCES'
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Attachment

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